

Bottom trawling keeps the geochemistry of the seafloor permanently out of steady state

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Introduction

Bottom trawling is a non-selective fishing technique in which chains are pulled over the seabed

-> Strongly alters the seafloor by "ploughing"[1]
-> Impact on sedimentary biogeochemical cycling and microbial communities not yet studied

Bottom trawling is intensively applied in the Belgian and Dutch part of North Sea (Fig. 1)

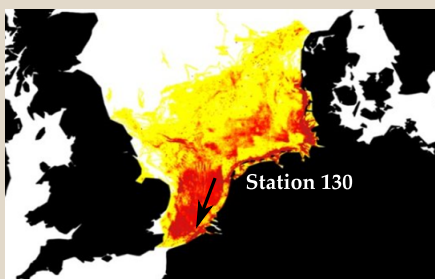
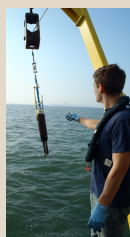


Fig. 1: intensity of bottom trawling in the North Sea [2]

Field site: Station 130 (51° 16.3' N, 2°54.3' E), consists of cohesive clay and mud, rich in organic matter and carbonate

Sampling date: Between May 2014 and June 2014 the seafloor at St130 was impacted. Samples were collected on June 2014, July 2014, September 2014

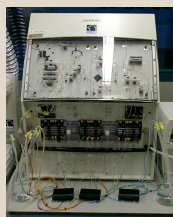
Material and methods



Sediment core collection with a gravity corer on board RV Simon Stevin



Core slicing under anaerobic conditions, porewater extraction through centrifugation



Porewater analysis for DIC, major cations, sulphate, nutrients, trace metals.
Solid phase analysis for POC, PIC, TN, porosity

Conclusions

Pore water returns to initial steady-state conditions within ~4 months

-> a trawling frequency of 3 times per year is sufficient to keep the seafloor in a permanent transient state

This transient states favours suboxic over anoxic mineralization pathways (Fig. 3) and potentially prevents burial of organic matter and reduced minerals

-> High-frequency bottom trawling will leave a clear anthropogenic imprint on the biogeochemical cycles in marine environments.

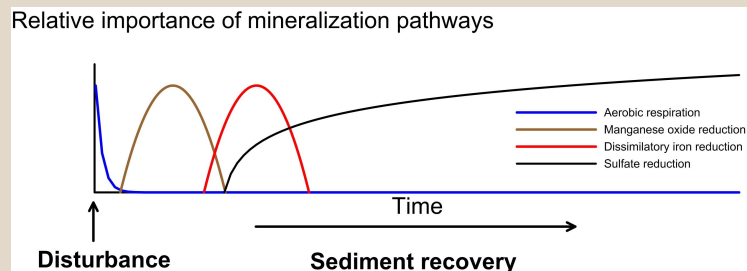


Fig. 3: conceptual figure of the relative importance of the mineralization pathways, based on the interpretation of the pore water profiles of Fig. 2.

Results

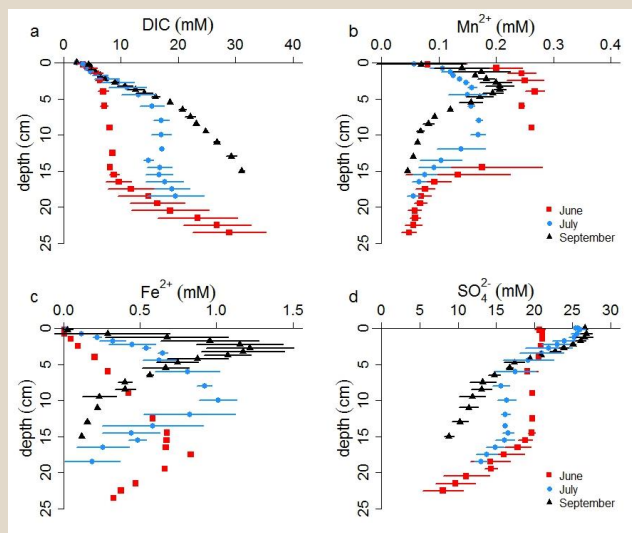


Fig. 2: porewater profiles showing the evolution of DIC, dissolved Fe, dissolved Mn and sulfate in three months (June, July, September) following a major impact event in May 2014.

Pore water accumulation of manganese and iron in September show the signature profile of electrogenic sulfur oxidation and are not related to mineralization of organic carbon.

Dissolved Inorganic Carbon (DIC): DIC is released by mineralization of organic carbon (OMM). Evolves from a straight profile in the upper 15 cm to its steady-state. Shows the recovery of organic matter mineralization.

Dissolved manganese (Mn): Mn is released by manganese oxide reduction coupled to OMM. Highest pore water accumulation in June -> manganese oxide dominant electron acceptor in June.

Dissolved iron (Fe): Fe is released by iron oxide reduction coupled to OMM. Highest pore water accumulation in July -> iron oxide dominant electron acceptor in July.

Sulfate (SO₄²⁻): Sulfate is consumed by sulfate reduction coupled to OMM. Highest depletion in September -> Sulfate dominant electron acceptor in September.

References

- [1] Puig et al., 2012, *Nature* **489**, 286-289
[2] <http://www.benthis.eu/>



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